

What is claimed is:

1. A developing device comprising:

(a) a rotary developer carrier facing a latent image carrier for carrying a developer comprising a toner and a carrier;

(b) a rotary developer supply and collection member for supplying the developer to and collecting from the developer carrier;

(c) a first rotary developer stirring member for stirring the developer while conveying and circulating the developer;

(d) a second rotary developer stirring member for stirring the developer while conveying and circulating the developer between the first and second developer stirring members,

wherein the developer carrier, the developer supply and collection member, the first developer stirring member and the second developer stirring member are arranged in a housing in parallel with each other in this order in a direction leaving the latent image carrier, and

wherein conveyance directions of the developer of the first and second developer stirring members are opposite to

each other with respect to rotary axis directions thereof, and conveyance power for the developer thereof is substantially identical to each other;

(e) a third rotary developer stirring member for stirring the developer, having a length in a rotary axis direction smaller than that of the second developer stirring member and a conveyance power for the developer in a rotary axis direction that is substantially zero, provided facing the second developer stirring member at a position corresponding to an upstream portion of and farther than the second developer stirring member in the housing; and

(f) a toner replenishment inlet through which a new toner is replenished, provided in the housing at an upper position of a part where circumferential surfaces of the second and third developer stirring members face each other, and on an upstream side in the conveyance direction of the developer of the second developer stirring member,

wherein the third developer stirring member is rotated so that the circumferential surface thereof moves downward in the same direction as that of the circumferential surface of the second developer stirring member at the position where the circumferential surfaces of the second and third developer stirring members face each other.

2. The developing device of claim 1,

wherein each of the first and second developer stirring members comprises a shaft and a stirring member extending spirally in the rotary direction over an outer circumferential surface of the shaft, and

wherein the third developer stirring member comprises a shaft and a plurality of plate-shaped stirring members provided to be inclined to the shaft in the same direction, and through each of which the shaft passes.

3. The developing device of claim 1,

wherein each of the first and second developer stirring members comprises a shaft and a stirring member extending spirally in the rotary direction over an outer circumferential surface of the shaft, and

wherein the third developer stirring member comprises a shaft and ribs extending along the rotary axis direction, provided at positions spaced apart from an outer circumferential surface of the shaft in a radial direction of the shaft.

4. The developing device of claim 1, wherein circumferential surfaces of the developer carrier and the developer supply and collection member move in an opposite direction to each other at a part where the circumferential surfaces of the developer carrier and the developer supply and collection member face each other.

5. The developing device of claim 1, wherein the developer is a two-component developer comprising a toner having a volume average particle diameter of 3 to 5 μm , and a carrier having a volume average particle diameter of $5 \times D_t$ μm to $10 \times D_t$ μm , where D_t (μm) represents the volume average particle diameter of the toner.

6. The developing device of claim 2, wherein circumferential surfaces of the developer carrier and the developer supply and collection member move in an opposite direction to each other at a part where the circumferential surfaces of the developer carrier and the developer supply and collection member face each other.

7. The developing device of claim 2, wherein the developer is a two-component developer comprising a toner having a volume average particle diameter of 3 to 5 μm , and a carrier having a volume average particle diameter of $5 \times D_t$ μm to $10 \times D_t$ μm , where D_t (μm) represents the volume average particle diameter of the toner.

8. The developing device of claim 3, wherein circumferential surfaces of the developer carrier and the developer supply and collection member move in an opposite direction to each other at a part where the circumferential surfaces of the developer carrier and the developer supply and collection member face each other.

9. The developing device of claim 3, wherein the developer is a two-component developer comprising a toner having a volume average particle diameter of 3 to 5 μm , and a carrier having a volume average particle diameter of $5 \times D_t$ μm to $10 \times D_t$ μm , where D_t (μm) represents the volume average particle diameter of the toner.

10. An image forming apparatus comprising:

(a) a latent image carrier for carrying an electrostatic latent image; and

(b) a toner image forming device for forming a toner image by developing the electrostatic latent image formed on the latent image carrier, having the developing device according to claim 1, wherein the following conditions (i) and (ii) are satisfied,

$$W \geq M \cdot V \cdot L / 1000 \quad (i), \text{ and}$$

$$R \leq 600 \quad (ii)$$

where V (mm/s) represents a circumferential moving speed of the latent image carrier, M (mg/cm²) represents a maximum amount of adhesion per unit area of a toner image formed on the latent image carrier, L (mm) represents a maximum width of the toner image formed on the latent image carrier in a direction perpendicular to a circumferential moving direction, W (g/s) represents an amount of movement of the developer with respect to the rotary axis direction of the first developer stirring member, and R (rpm) represents a speed of rotation of the first developer stirring member.

11. An image forming apparatus comprising:

(a) a latent image carrier for carrying an electrostatic latent image;

(b) a toner image forming device for forming a toner image by developing the electrostatic latent image formed on the latent image carrier, having the developing device according to claim 1, wherein the developing device further comprises a recycling toner mixing opening for mixing a collected toner with the developer, that is provided in the housing at the upper position of the part where circumferential surfaces of the second and third developer stirring members face each other, and on an upstream side of the opening through which the new toner is replenished, with respect to the conveyance direction of the developer of the second developer stirring member;

(c) a transfer device for transferring the toner image on the latent image carrier onto a transfer material or an intermediate transfer body;

(d) a cleaning device for removing the toner remained on the latent image carrier after passed through a transfer region by the transfer device; and

(e) a toner recycling device for collecting the toner removed from the latent image carrier by the cleaning device back to the recycling toner mixing opening of the developing device in the toner image forming device to reutilize.